

Inter-disciplinary teaching program

Principle investigator : Professor T. J. Chuang (Center for Condensed Matter Sciences)

1. Introduction

We plan to establish an Inter-Disciplinary Teaching Program (IDTP) on Nano-Science and Technology (NST) involving relevant colleges and research centers in NTU. The main subjects of IDTP shall be focused on basic science, applied engineering and biotechnology (The framework is shown in Figure 7) directly related to NST, with curriculum covering various levels from undergraduate to Ph.D. Meanwhile, we will collaborate with Academia Sinica in the joint International Graduate Program on NST to offer Ph.D. degrees for international students. The overall objectives of these programs are to cultivate young scientists and engineers specialized in NST for both academic excellence and meeting the needs of national industrial development.

2. Objectives

We will integrate and enhance the diversified teaching courses related to NST presently existed in various colleges and research centers in NTU (e.g., Colleges of Science, Engineering, Agriculture, Medicine, Electrical Engineering/Computer Science, Center for Condensed Matter Sciences and Center for Biotechnology), and establish a unified Inter-Disciplinary Teaching Program (IDTP). The IDTP will be classified into three major Groups with emphasis on "Basic science", "Applied engineering" and "Biotechnology", respectively. Undergraduate and graduate students finishing both core and elective courses will earn program certificates in the initial period. Eventually M.S. and Ph.D. degrees in NST will be offered. In parallel efforts, a joint International Graduate Program (IGP) with participating institutes of Academia Sinica (AS) will be set up for international students. The combination of programs can provide a full range of selections and clear objectives for training new generations of specialized scientists and engineers.

3. Approach

(1) Primary goals

The IDTP is set up to enhance and integrate teaching programs within NTU and to collaborate with Academia Sinica on IGP in the fields of NST. The combined effects can provide students with optimal training for certificates and graduate degrees. The IDTP in NTU will be classified into three major Groups : Basic Science, Applied Engineering and Biotechnology with faculty participation from various colleges and research centers. Specifically, the first step involves the integration of the current Nano-Science Program in the College of Science and Nano-Engineering Program in the College of Engineering into the unified IDTP-NTU. These two will actually evolved into the Basic Science and Applied Engineering Groups within IDTP. The second step is to install the Biotechnology Group inside IDTP by extending the existing Biotech program with particular emphasis on NST aspects.

The unique features of this IDTP include: (1) It shows effective integration among different disciplines, departments, institutes and colleges with experts in NST related fields for optimal performance in both teaching and research programs. (2) It actually encompasses basic science, applied science, engineering and biotechniques. NTU has demonstrated strength in these areas and IDTP can make them even more outstanding. (3) In addition to class-room lectures, experimental courses in labs will be emphasized to acquire hand-on experiences. (4) It covers students with potential interests from undergraduate to Ph. D levels, and thus can cultivate all kinds of skillful personnel to meet national needs. (5) It strongly encourages teachings and interactions in English to enhance international exchange and competition. (6) It strongly supports foreign collaboration and visiting exchange, in particular, for distinguished scholars with extended teaching/research stay in NTU. (7) It closely collaborates with Academia Sinica to expand and enrich the scope of the endeavor. (8) Overall, the fields of NST are exciting and challenging by themselves. In aggregate, they will have huge impact on industrial and economical developments, on societies in general, and indeed on human civilization for decades to come. It is a subject of continuing evolution touching the basic core of matters and the essence of life. It should be a very attractive subject for generations of young people to pursue.

(2) Principal investigators

PI : Tung J. Chuang (Director, Center for Condensed Matter Sciences and Professor, Dept. of Physics)

Co-PI : C. R. Chang (Phys. Dept.) ; Y. F. Chen (Phys. Dept.) ;

P. T. Chou (Chem. Dept.) ; S. H. Chang (Mech. Eng. Dept.) ;

T. Liu (Mech. Eng. Dept.) ; C. W. Lin (Inst. Biomed. Eng.) ;

C. C. Yang (Electr. Eng. Dept.) ; C. K. Hwu (Electr. Eng. Dept.) ;

Y. M. Chen (Center for Biotech. and Botany Dept.)

All PI's are experts in certain subjects related to NST, and have extensive experiences in teaching and leading major integrated research projects. The overall PI, T.J. Chuang, is a pioneer in surface photochemistry with specialty in the physics and chemistry at materials interfaces, and spectroscopic and microscopic analytical techniques. In recent years, he has led major joint projects including "Synchrotron Radiation and Spectromicroscopy on Nanostructures Related Chemistry, Biology and Electronics Materials" (supported by NSC and AS, 1995-1998), "Nanoscope Surface Structures and Chemistry" (AS, 1999-2002), and "Basic Research on Advanced Materials - Carbon and Nitrogen Based Materials and Nanostructures" (Ministry of Education - Academic Excellence Project, 2000-2004). T. J. Chuang has held honorable Chair for Outstanding Scholarship (1995-2000 and 2000-2005) and NTU University Chain Professor (1998-2000). He is a Fellow and Chartered Physicist of the Institute of Physics (U.K.), and has served on the Advisory Boards for a number of research institutes and scientific journals.

(3) Participating team

Apart from the PI's, there are more than 30 faculty members to participate in IDTP. The key members for the "Basic Science" Group include P. T. Chou, L. C. Chen, C. R. Chang, Y. F. Chen, S. H. Chang and C. C. Yang, etc.; for the "Applied Engineering" Group, S. C. Lee, H. P. Huang, C. C. Yang, Y. H. Lee, C. K. Hwu and C. K. Lee, etc.; for the "Biotechnology" Group, Y. M. Chen, C. W. Lin, Y. T. Shyu and S. M. Lin, etc.

For the joint IGP efforts with Academia Sinica, the key AS members include T. T. Tsong, Y. D. Yao and J. S. Chang of the Physics Institute ; T. Y. Luh and Y. T. Tao of the Chemistry Institute ; S. H. Lin, Y. L. Wang and K. H. Chen of the Atomic and Molecular Science Institute ; C. S. Tsai and P. K. Wei of the Applied Science and Engineering Institute, etc. In fact, a number of NTU team members are in the planning committee for IGP. These include C. R. Chang, Y. F. Chen, L.C. Chen and T. J. Chuang. When the IGP course instruction begins in 2004, many more NTU faculty members will join in the teaching. Thus, the close collaboration between NTU and Academia Sinica can be further strengthened.

a. Manpower

Each major Group in IDTP needs two teaching assistants and a supplemental personnel to help with lecture preparation, problem solving, laboratory set-up, instrument maintenance, sample treatments, safety and student guidance, etc. Thus, we plan to have a total of 6 regular teaching assistants and 3 supplemental. In addition, a budget for 3 man-year distinguished visiting scholars will be allocated to promote international collaboration.

b. Outcome

The facility in all three major Groups in IDTP will be expanded to have a full range of experimental trainings in laboratories, in addition to class-room lectures. Thus, a complete IDTP team and facility will be available for training both undergraduate and graduate students. Depending on external demands, this teaching program may be expanded in the future to accommodate non-NTU people desired to acquire NST skills.

c. Teacher / student ratio

More than 35 faculty members will participate in teaching. For class-room lectures, the teacher/student ratio will be greater than 1:10, while that ratio will increase to 1:5 or higher for experimental instruction in the labs.

(4) Action items

- a. To expand and complete the experimental facilities for the Basic Science Group.
- b. To establish new experimental labs and facilities for Applied-Engineering Group.
- c. To set up Biotechnology Group including lectures and experiments with emphasis on NST aspects.
- d. To complete the planning for IGP with Academia Sinica and start the teaching program in 2004.
- e. To apply to the Ministry of Education for allowing IDTP to offer M.S. and Ph.D. degrees.

(5) Execution procedure and steps

Two committees, namely "Curriculum Committee" and "Graduate Degree Planning Committee", will be set up to draw up detailed plans for courses and for offering advanced degrees, respectively. The required and elective courses for each of the Basic Science, Applied Engineering and Biotechnology Groups will be decided. Students will be assigned to counseling teachers. Graduate students can select their own thesis advisors. Once approved, the IDTP can start in 2003-2004.

(6) Funding and resources needed

a. Applied funds

For the 3-year IDTP project, please refer to the budget request table listed at the end of the proposal.

b. Manpower

NTU regular faculty : more than 30 members

Distinguished visiting scholars : 3 man-years

Teaching assistants : 6, and Supplemental : 3.

c. Space

The total space needed for class rooms, experimental labs, discussion/meeting rooms, faculty offices and one administration office is about 900 m².

d. Administration personnel

One full time administration assistant is needed for the office.

4. Expected achievements

a. Completion of an integrated teaching program on NST within NTU covering basic science, engineering and biotechnology areas. Skillful scientists and engineers from B. S. to Ph. D. levels are cultivated for both academic excellence and meeting the national needs for industrial development.

b. Close collaboration with Academia Sinica on both teaching and research in NST fields to achieve a level in par with the first-class universities in the world.